Name of the Student:_____

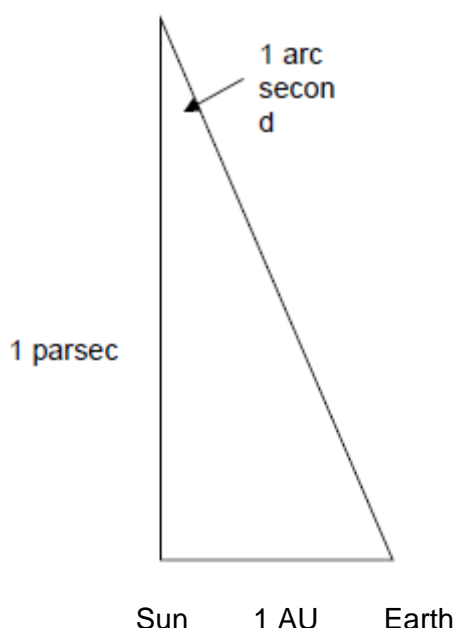**Max. Marks : 23 Marks**   **Time : 23 Minutes**

Mark Schemes

Q1.

(a)   Diagram showing Earth, Sun and star, with 1AU clearly marked, and 1 arc second angle at the star, with distance between Sun and star as one parsec.

1 pc is the distance at which 1AU subtends an angle of 1 arc second

> *A diagram with fewer labels can be supported by a correct statement.*
> *If either the angle or base are incorrect, 1 max.*
> *Right angle does not need to be at the Sun. Triangle does not need to be a right angle.*
> *Parsec could be the hypotenuse.*
> *Ignore writing if the diagram is correct.*
> *Base can be either Sun, Earth, or 1AU.*
> *No diagram, 1 max.*

2

(b)   d = 1 / p

= 1 / 0.002 parsec
= 500 pc ✓
= 500 × 3.1 × 10^{16} m
= 2 × 10^{19} m ✓ 1sf ✓

> *Allow ce for d in pc.*
> *If tan (0.002 / 3600) = 1AU / d used, allow ce for wrong value of 1AU.*

Allow use of tan or sin.

(c) (i)   Two components are 178 pc apart
or
Distance apart too great
(for gravity to have any significant effect between them)

> *Penalise attempts to hedge bets by references to apparent magnitude or class.*

1

(ii)   More distant star will not appear to move as much as nearest star (against the fixed background)

> *Allow discussions involving parallax.*
> *Give credit to correct diagram.*

1

[7]

Q2.

(a)   5.31, 6.38 ✔

> *Exact answers only*

1

(b)   Both points correctly plotted to the nearest mm ✔
Well drawn straight line of best fit. ✔

> *The orange LED point (4.80, 1.54) is anomalous. The line should follow the trend of the points (ignoring the anomalous point) with an even scatter of points on either side of the line.*

2

(c) (i)   Triangle drawn with smallest side at least 8 cm in length. ✔
Correct readings taken from the line for the triangle. ✔
Gradient in range 0.44 to 0.46 (0.435 to 0.464) $\times 10^{-14}$ quoted to 2 or 3 significant figures ✔

> *The size of the triangle can be implied by readings taken from the line. The third mark is independent of the other two: error carried forward for incorrect readings (or for a poor line of best fit) which give a gradient out of range is not allowed. Unit not required for the mark.*

3

(ii)   Possible marking points:
The anomalous point makes the value less reliable. ✔
(However) the (other) points are close to the line of best fit. Suggesting that the value is reliable. ✔

> *If the candidate has not ignored the anomalous point when drawing the line of best fit accept:*
> *The points are not close to the line of best fit so the value is not reliable* ✔
> *for one mark only*

2

(d) (i)   Recognition that the gradient = h/e ✔
$h = 0.45 \times 10^{-14} \times 1.60 \times 10^{-19}$ ✔
= (6.95 to 7.44) $\times 10^{-34}$ Js ✔

> *Allow ecf from (c)(i) for second mark (including wrong exponent)*
> *Final answer must be in range, have correct exponent, correct unit and*

be quoted to 2 or 3 sf

3

(ii) $((7.2 \times 10^{-34} - 6.63 \times 10^{-34})/ 6.63 \times 10^{-34}) \times 100\%$
       calculated correctly✔

       Allow ecf from (d)(i): expected answer 8.6%

$$Allow \quad \frac{\left(7.2 \times 10^{-34} - 6.63 \times 10^{-34}\right) \times 100\%}{7.2 \times 10^{-34}} \quad giving\ 7.9\%$$

       No sf penalty

1

(iii)   ± 1.1% or + 1%✔

       ± is required here as it is explicit in the question

1

(iv)   %uncertainty in f = 8.6 – 1.1 = 7.5%✔
       ∴ δf = ± 0.075 × 3.19 × 1014 ✔
       = ± 2.39 × 1013 Hz ✔

       Allow ecf from (d)(ii)
       Final answer: 2 or 3 sf with unit but ± symbol not required

3

16